Claims

I claim:

1. A check valve assembly for a cooling gas nozzle in a vacuum heat treating furnace, comprising:

   A. a valve body having an inlet, an outlet, and a channel that extends through the valve body between the inlet and the outlet;

   B. a chamber formed in the valve body adjacent the inlet and in fluid communication with the channel, said chamber having a recess formed therein; and

   C. a flap that is pivotally supported in said chamber adjacent the inlet for moving inwardly into the recess of said chamber such that said flap pivots between a closed position where the inlet is closed and an open position in which the channel is not obstructed.

2. The check valve assembly of claim 1, comprising a shaft for supporting said flap, said shaft extending through an edge of said flap and having end portions supported by the valve body in said chamber.

3. The check valve assembly of claim 1, wherein the valve body and the flap are formed of a refractory material.

4. The check valve assembly of claim 1, wherein the valve body and the flap are formed of graphite or a ceramic material.

5. The check valve assembly of claim 2, wherein the shaft is formed of molybdenum.

6. The check valve assembly of claim 1, wherein the flap is dimensioned to fit entirely within the recess.

7. A check valve assembly for a cooling gas nozzle in a vacuum heat treating furnace, comprising:

   A. a valve body having an inlet, an outlet, and a channel that extends through the valve body to permit a cooling gas to flow through the valve body;

   B. an inner wall in the valve body, said inner wall forming a recess near the inlet that extends into the inner wall;

   C. a shaft extending through the recess; and

   D. a flap pivotally supported on the shaft, said flap being operable between a closed position in which the flap is pivoted into the channel to substantially obstruct cooling gas flow through the channel, and an open position in which the flap is pivoted into the recess, said flap being configured to conform to the shape of the recess to remain flush with the inner wall while in the open position.

8. The check valve assembly of claim 7, wherein the valve body and the flap are formed of graphite or a ceramic material.

9. The check valve assembly of claim 7, wherein the shaft is formed of molybdenum.

10. A vacuum heat treating furnace comprising:

   A. a vacuum vessel having a vessel wall;

   B. a hot zone disposed in said vacuum vessel, said hot zone having a hot zone wall;

   C. a plenum formed between the vessel wall and the hot zone wall;

   D. a plurality of nozzles extending through the hot zone wall to

interconnect the plenum and the hot zone;

D. a cooling gas system for providing a forced cooling gas into the plenum; and

E. a plurality of check valves connected to the nozzles externally of the hot zone wall.

11. The vacuum heat treating furnace of claim 10, wherein each of said check valves comprises:

A. a valve body having an inlet, an outlet, and a channel that extends through the valve body between the inlet and the outlet;

B. a chamber formed in the valve body adjacent the inlet and in fluid communication with the channel, said chamber having a recess formed therein; and

C. a flap that is pivotally supported in said chamber adjacent the inlet for moving inwardly into the recess of said chamber such that said flap pivots between a closed position where the inlet is closed and an open position in which the channel is not obstructed.

12. The vacuum heat treating furnace of claim 11, wherein the valve body and the flap are formed of graphite or a ceramic material.

13. The vacuum heat treating furnace of claim 12, wherein the shaft is formed of molybdenum.

14. The vacuum heat treating furnace of claim 11, wherein the shape of the flap conforms with the shape of the recess, said flap being configured to rest in the recess flush with the inner wall in the channel when the flap is in the open position.

15. The vacuum heat treating furnace of claim 11, wherein the outlet of each check valve is connected to the hot zone wall by a fitting, said fitting being configured to position the check valve so that the inlet faces into the cooling gas stream and the flap is biased toward the closed position by gravity.

16. A hot zone for a vacuum heat treating furnace comprising:

A. a closed wall defining an internal volume;

B. insulation means disposed over an interior surface of said closed wall;

C. a plurality of nozzles disposed in said closed wall for injecting a cooling gas into the hot zone; and

D. a plurality of check valves each being connected to one of the nozzles externally of the closed wall.

17. A hot zone as set forth in Claim 16, wherein each of the plurality of check valves comprises:

A. a valve body having an inlet, an outlet, and a channel that extends through the valve body between the inlet and the outlet;

B. a chamber formed in the valve body adjacent the inlet and in fluid communication with the channel, said chamber having a recess formed therein; and

C. a flap that is pivotally supported in said chamber adjacent the inlet for moving inwardly into the recess of said chamber such that said flap pivots between a closed position where the inlet is closed and an open position in which the channel is not obstructed.

18. The hot zone set forth in claim 16, wherein each of the check valves comprises a shaft for supporting said flap, said shaft extending through an edge of said flap and having end portions supported by the valve body in said chamber.

19. The hot zone set forth in claim 16, wherein the valve body and the flap are formed of a refractory material.

20. The hot zone set forth in claim 17, wherein the valve body and the flap are formed of graphite or a ceramic material.

21. The hot zone set forth in claim 16, wherein the shaft is formed of molybdenum.

22. The hot zone set forth in claim 1, wherein the flap is dimensioned to fit entirely within the recess.